KUMARAGURU
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Register Number: ……………………..

B.E DEGREE EXAMINATIONS: NOV/DEC 2014

(Regulation 2009)

Fifth Semester

MECHATRONICS ENGINEERING

MCT112**:** Design of Machine Elements

Time: Three Hours   **Maximum Marks: 100**

Answer all the Questions:-

PART A (10 x 1 = 10 Marks)

1. Toughness is the
    a) Ability of the material to absorb energy within elastic limit
    b) Ability of the material to resist indentation
    c) Area under the stress-strain curve
    d) Ability of the material to absorb energy within elastic and plastic range

2. Usage of stress concentration factor is unavoidable when
        i. Ductile materials under static load
        ii. Brittle materials under static load
        iii. Ductile materials under fluctuating load
        iv. Brittle materials under fluctuating load
    a) ii, iii, iv
    b) iii, iv
    c) ii, iv
    d) i,ii,iii,iv

3. In the assembly of pulley, key and shaft
    a) Pulley is made the weakest
    b) Key is made weakest
    c) Key is made strongest
    d) All the three members are designed for equal strength

4. The shearing area of a key of length L, breadth B and depth H is equal to
    a) B x H
    b) L x H
    c) L x B
    d) L x H/2

5. The parallel fillet welded joint is designed for
    a) Tensile strength
    b) Compressive strength
    c) Bending strength
    d) Shear strength

6. A bolt of uniform strength can be developed by
    a) keeping the core diameter of threads equal to the diameter of unthreaded portion of the bolt
    b) keeping the core diameter of threads smaller than the diameter of unthreaded portion of the bolt
    c) keeping the nominal diameter of threads equal to the diameter of unthreaded portion of bolt
    d) Core length

7. All the types of levers are subjected to
    a) Twisting moment
    b) Bending moment
    c) Direct axial load
    d) Combined twisting and bending moment

8. In the calculation of induced shear stress in helical springs, the Wahl's correction factor is used to take care of
    a) Combined effect of transverse shear stress and bending stress in the wire
    b) Combined effect of bending stress and curvature of wire
    c) Combined effect of transverse shear and curvature of wire
    d) Combined effect of transverse shear and torsional shear stress in the wire

9. Starting friction is low in
    a) Hydro-static lubrication
    b) Boundary lubrication
    c) Hydro-dynamic lubrication
    d) Mixed (or Semi-fluid) lubrication

10. In case of a flywheel, the maximum fluctuation of energy is the
    a) Sum of maximum and minimum energies
   b) Difference between maximum and minimum energies

| c) | Ratio of maximum and minimum energy | d) | Ratio of minimum and maximum energy |

PART B (10 x 2 = 20 Marks)

11. State maximum shear stress theories of failure.
12. List the factors that affect the endurance limit.
13. What is the function of transmission shaft?
14. In the design of Kennedy key the shear area is………and the Compression/crushing area is……
15. Why it is conventional to add 15 mm with the calculated length of the weld?
16. Where the threaded joints preferred over bonding?
17. List the functions of spring.
18. What is the function of lever? Define leverage.
19. Explain the term Dynamic load carrying capacities of rolling contact bearings.
20. Define bearing modulus as applied to the journal bearings.

PART C (5 x 14 = 70 Marks)

21. a) (i) The dimensions of an overhang crank are given in figure below. The force P acting at the crank pin is 1 kN. The crank is made of steel (σ_{ut} = 450 MPa) and the factor of safety is 2. Using maximum shear stress theory of failure, determine the diameter 'd' at the section X-X. (12)
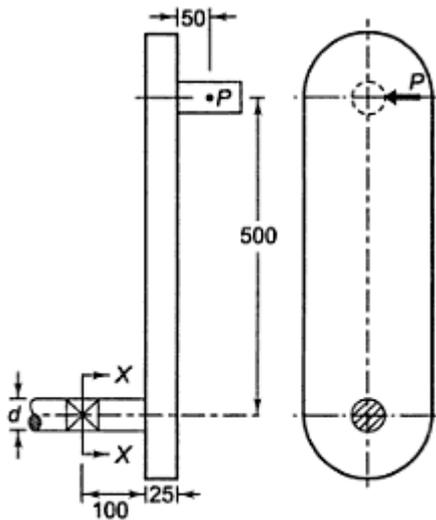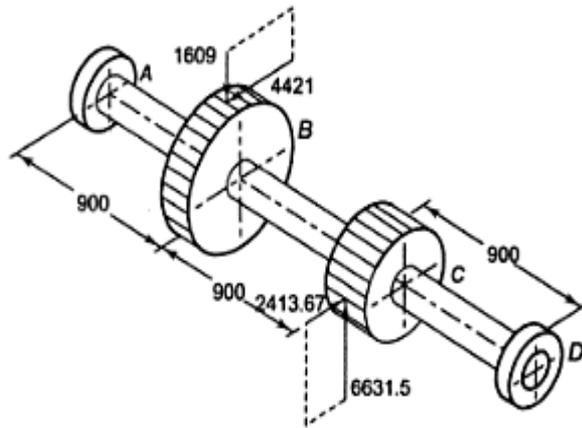

All dimensions in mm

    (ii) What is the necessary of using Factor of safety? (2)

(OR)

  b) (i) A forged steel bar, 50 mm in diameter, is subjected to a reversed bending stress of 250 N/mm^2. The bar is made of steel 40C8 (σ_{ut} = 600 MPa). Calculate the life of the bar for reliability of 90%. (10)

    (ii) What is meant by curved beam? Explain the factors that differentiate the analysis of straight beam and curved beam. (4)

22. a) The layout of an intermediate shaft of a gear box supporting two spur gears B and C is shown in figure below. The shaft is mounted on two bearings A and D. The pitch circle diameters of gears B and C are 900 mm and 600 mm respectively. The material of the shaft is steel (σ_{ut} = 770 MPa and σ_{yt} = 580 MPa). The factors k_b and k_t of ASME code are 1.5 and 2.0 respectively. Determine the shaft diameter using ASME code. Assume that the gears are connected to the shaft by means of keys.
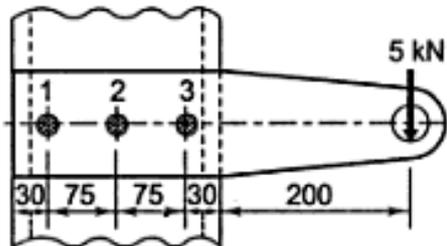
All dimensions are in mm

(OR)

b) It is required to design a rigid type flange coupling to connect two shafts. The input shaft transmits 37.5 kW power at 180 rpm to the output shaft through the coupling. The service factor for the application is 1.5. Select suitable materials for various parts of the coupling, design the coupling and specify the dimensions of its components.

23. a) (i) A steel plate subjected to a force of 5 kN and fixed to a channel by means of three (8) identical bolts is shown in figure. The bolts are made of plain carbon steel 45C8 (σ_{ut} = 380 MPa) and the factor of safety is 3. Specify the size of bolts.
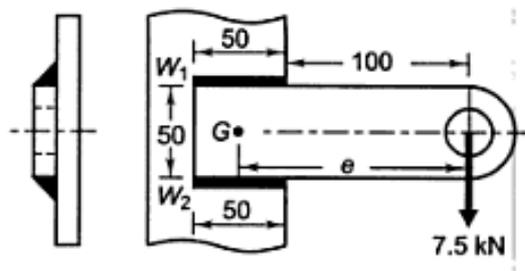

All dimensions are in mm

(ii) By changing the design, how the peeling effect can be reduced in case bonded joints? (6) Explain with neat sketch.

(OR)

b) A welded connection, as show in figure is subjected to an eccentric force of 7.5 kN. Determine the size of the welds if the permissible shear stress for the weld is 100 N/mm². Assume static conditions.

All dimensions are in mm

24. a) A direct reading tension spring balance consists of a helical tension spring, which is attached to a rigid support at one end and carries masses at the other free end. The pointer attached to the free end moves on a scale and indicates the mass. The length of the scale is 100 mm, which is divided into 50 equal divisions. The maximum capacity of the spring balance is 25 kg. The spring index is 6. The spring is made of an oil-hardened and tempered steel wire of Grade-SW (G = 81370 N/mm²). The permissible shear stress in the spring wire is recommended as 50% of the ultimate tensile strength. Design the spring and give its specifications.

(OR)

b) A pressure vessel, used in chemical industries, is shown in figure. It is designed to withstand an internal gauge pressure of 0.25 MPa. The cover is held tight against the vessel by means of a screw, which is turned down through the tapped hole in the beam, so that the end of the screw presses firmly against the cover. The links L1 and L2 are

attached to the beam on one side and to the extension cast on the vessel on the other side. The vessel and its cover are made of grey cast iron FG200. The beam, screw, links and pins are made of FeE 250 (σ_{ut} = 250 MPa). The factor of safety for all components is 5. The beam has rectangular cross section and the ratio of width to thickness is 2:1. Assume the following data for screw:

| Size	Pitch (mm)	Stress area (mm^2)
M 30	3.5	561
M36	4	817
M42	4.5	1120
M48	5	1470

Determine
- i. Diameter of the screw
- ii. Dimensions of the cross-section of the beam
- iii. Diameter of pins at A, B, C and D
- iv. Diameter of link L1and L2
- v. Dimensions of cross-section of the support for pins A and B.
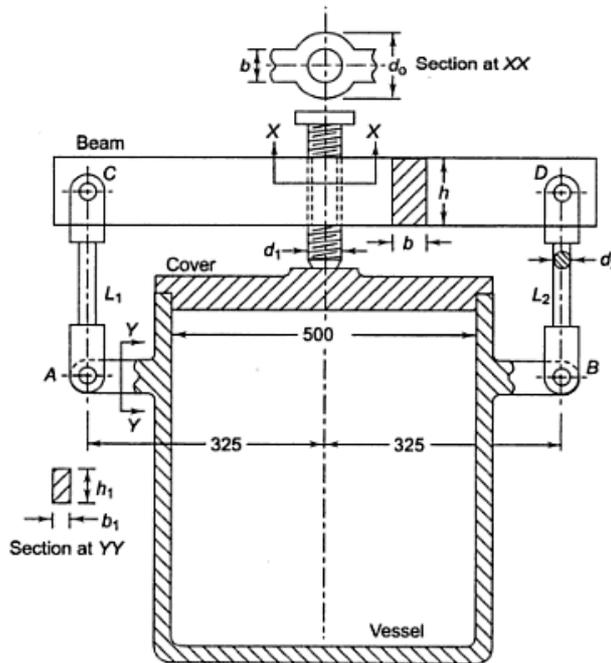
All dimensions are in mm

25. a) A transmission shaft rotating at 720 rpm and transmitting power from the pulley P to the spur gear G is shown in figure. The belt tensions and the gear tooth forces are as follows: P_1 = 498 N, P_2 = 166 N, P_t = 497 N, P_r = 181 N

The weight of the pulley is 100 N. the diameter of the shaft at bearings B_1 and B_2 is 10 mm and 20 mm respectively. The load factor is 2.5 and the expected life for 90% of the bearings is 8000 hours. Select single row deep groove ball bearings at B_1 and B_2.
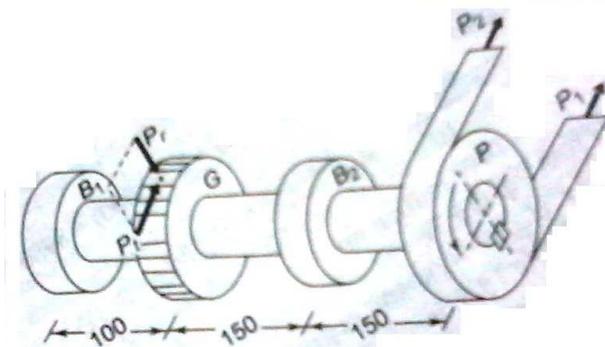
All dimensions are in mm

(OR)

b) A journal bearing is proposed for a centrifugal pump. The diameter of the journal is 0.15 m and the load on it is 40 kN and its speed is 900 rev/min. Complete the design calculation for the bearing.